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LXXIV.—*On the Blow-holes and Nasal Passages of the Cachalot* (*Physeter macrocephalus*). By FRANK E. BEDDARD, D.Sc., M.A., F.R.S.

WE are well acquainted with the characters of the blow-hole of this Cetacean through the observations of several persons, and the structure of the nasal passages has been described comparatively recently by Pouchet and Beau-regard*, who sum up previous knowledge. But less is known of the condition of these in the fœtus. I have myself contributed something to the external characters of the blow-hole in several fœtuses of different ages in two recent communications to the 'Annals of the Durban Museum'†. Since then the youngest of these fœtuses has furnished me with the opportunity of discovering something of the development of the organs in question. The material

* "Recherches sur le Cachalot," *Nouv. Arch. Mus.* (3) vol. iv. (1889).

† "Contributions to the Knowledge of the Anatomy of the Sperm-Whale (*Physeter macrocephalus*), based upon the Examination of a young Fœtus," vol. i. pt. 2 (1915), and vol. ii. pt. 4 (1919). It had been arranged that this series of contributions should be continued; but, unfortunately, the Government found themselves unable to continue the grant of money, and the Journal has had to cease publication for the present.

I owe to the kindness of Mr. Chubb, the Curator of the Durban Museum. The authorities of the College of Surgeons were so good as to allow their skilled assistant Mr. Steward to prepare for my use (and for other persons in the future) a complete series of sections of the head. My thanks are tendered to these gentlemen.

§ *The Communication of the Nasal Passages with the Blow-hole.*

In drawings of the blow-holes of this foetus *, and in the accompanying letterpress, I have indicated a practically continuous furrow, forming the right and left blow-holes laterally, and consisting in front of a much shallower connecting region, concerning the actual existence of which I was unable, indeed, to be perfectly certain. There was no doubt, however, about the quite deep right and left blow-holes. I find on examination of my sections that the median region of what is therefore at this stage a single blow-hole is by no means missing; and that the impression which it gave me—on examining it merely with a lens—as a shallower connecting furrow was correct. For, as a matter of fact, the two nasal tubes, quite distinct from each other until the very edge (in front) of the nasal region of the head, open into and form a perfectly continuous groove extending right round the anterior convexity of the nasal portion of the head—imperfectly shown in the drawings to which I have just referred. The reason why there appeared to me to be a doubt about the matter, when describing the external characters of this foetus, is at once explained by an examination of the sections. There it will be seen that the detached epithelial lining of this region of the blow-holes, which has a rod-like form (as will be explained later), partially blocks the linear orifice and gives it the appearance of a shallow, and even in parts non-existent, groove.

It will be seen from the series of transverse sections, which are arranged in order from in front backwards, that the two nasal passages, right and left, both open into what obviously represents a common chamber, which itself in this young foetus has a single median anterior aperture corresponding exactly to the median part of the combined single blow-hole. As I have partly indicated in the external figures referred to, two furrows lead from the left- and right-hand corners of this median orifice, which are the right and

* *Loc. cit.* vol. ii. pt. 4, Oct. 1919, p. 135, text-figs. 1-4.

left blow-holes respectively. One of these, the right, continues to be connected with the common chamber, as we may term it; but as it passes backwards, *i. e.*, along the longitudinal axis of the body—and therefore at right angles to the anterior orifice of the chamber,—it opens along the *side* of that chamber. On the other hand, the orifice of the left nasal tube has a different course as we trace it backwards from its opening into the conjoint anterior furrow. It becomes freed at once from its connection with the anterior furrow, and is seen in the transverse sections as a perfectly independent groove.

I have directed attention in my earlier communication on this fœtus, in the paper referred to below *, to the fact that the left blow-hole is longer than the right—or, rather, than that part of the right blow-hole which is distinctly lateral in position; for it is impossible, as I have just shown, to draw an absolute line of demarcation as to where the lateral region is to be distinguished from the anterior furrow. This is not quite so clear in the figures which I then gave as it might have been; this, however, is due to the curvature of the sides of the head and the consequent view of the furrow partly in profile. I have been able in my microscopical examination of the fœtus to compare the lengths more accurately by counting the actual sections, and comparing the numbers which contain, with those that do not contain, the grooves of the two blow-holes. I have found that the right blow-hole runs back through 20 sections, while the left is prolonged backwards for another 44 sections, being thus about three times its length. The actual measurements work out at 1·6 mm. in the case of the left furrow and ·5 mm. in the case of the right-hand one. The disparity, however, must be rectified by the extension round the corner—so to speak—of the right blow-hole. But, in any case, the left blow-hole furrow does reach further back than its fellow of the right side. The asymmetry of the head is already well established in this fœtus, as will be pointed out in the case of other structures as well as the blow-holes.

§ *The Course of the Two Nasal Passages to the Point where they unite to form the Nasal Pharynx.*

It will have been gathered from the foregoing account of

* *Loc. cit.* Ann. Durban Mus.

the external orifices of the nasal passages that the right-hand passage ends anteriorly in a funnel-shaped dilatation, while that of the left side is tubular throughout this region, and for the rest of its course is represented merely by the external groove. The large chamber forming the funnel of the right nasal passage gradually narrows into a "stem," and the left-hand nasal passage passes inwards from the external groove, in which it ends externally. The two come close together. It is to be noted that their position within the head is not symmetrical. The right-hand tube occupies as nearly as possible the centre of the cross-diameter of the head, while the left nasal tube is therefore necessarily on the left-hand side. Furthermore, both tubes lie nearer to the dorsal surface of the head, being at the end of the first one-sixth of the vertical diameter. With them, both above and between, are certain cartilages which will be dealt with later. The two nasal passages are by no means circular in outline. Their exact form differs in different regions. In the first section they are much flattened from above downwards, and are thus even slit-like. In this region they also lie obliquely to the longitudinal axis of the head, the tilt being upwards on the left side. The two passages are not quite in the same plane, the left being rather dorsal to the right. They are, however, at any rate, roughly of the same length. A little later on, the left nasal passage becomes smaller than the right and alters its angle of position. The right tube maintains its obliquity in reference to the axis of the head, while the left becomes entirely parallel to the horizontal axis.

Both these changes are accomplished at a distance of some 4.9 mm. from the end of the snout. A little later there is a further change. The left-hand tube grows smaller than the right, and its long axis is now bent downwards, as is that of the right, and the angle between them gradually diminishes. This state of affairs goes on developing, and at last the two nasal passages lie completely parallel with each other, but with the long axes of both parallel with the vertical axis of the head. At the same time the size of the tubes becomes again equal. All this is accomplished at a further distance of about 3.3 mm. from the last point which was measured.

As we follow the series of sections away from the blow-holes, the two nasal passages retain their vertical position, but, instead of remaining of equal size, the left becomes

bigger—a state of affairs quite the reverse of that which we have just seen to occur. A little later they again become equal, though still remaining parallel and vertical in position with reference to the head. This point is 2.1 mm. further on.

Very soon, indeed, the axis of the two nasal passages, though themselves remaining quite equal in size, come to lie at an angle with each other; but that angle is exactly the reverse of what it has been, and they bend away from each other at their *upper* and *not* at their *lower* ends. There is no further alteration of moment until the two tubes fuse to form one—the nasal pharynx,—which point is at the distance of another 2 mm.

It will be obvious, of course, that on a lateral view the nasal passages would be seen to slope gradually downwards from their original position on a level with the blow-holes. The various changes in the position of the two nasal canals with reference to each other—*i. e.* the mutual and continually differing angles—indicate that the left canal, at any rate, is spirally arranged, and, in fact, turns upon itself along the whole length half a turn. The right canal is very nearly the same, but a slight complication is introduced by the huge size of its terminal chamber.

The symmetry of the two tubes is another matter of interest. As has been pointed out, they are not at first symmetrical with the axis of the head. Later on, however, they come to lie pretty exactly one on either side of the vertical median line. This rectification of the asymmetry visible in the anterior part of the head is visible about 2.7 mm. from the end of the snout or possibly a trifle earlier.

A third matter worthy of attention is that the two canals fluctuate in size at more than one place. Each tube, seen foreshortened, would appear moniliform. This change of size, however, is limited to the area in front of the final arrangement of the two tubes at an angle diverging from the ventral side. They are thereafter exactly of the same size. Nor is their opening into the nasal pharynx associated with any increase or diminution of size in one or the other. They simply fuse.

§ *Comparison of the Nasal Passages in the Fetus with those of the Adult Whale.*

The chief authorities known to me on the structure of

these parts in the Cachalot are Pouchet and Beauregard *, to whose memoir I have had to refer so often in this series of contributions. It would seem that the right nostril undergoes a further differentiation of the large terminal chamber. This clearly closes up in front, except for where it communicates with the exterior in common with the left nostril, in the way in which I pointed out as probable in my account of the external characters of this foetus †. The authors mentioned speak of the "Développement exagéré de la narine droite avec son sinus." The sinus is a diverticulum of the following tract of the right nasal passage, the anterior dilatation being a specialised pouch opening into the "sac de l'évent," which is the common chamber of both nostrils.

Posteriorly the two nasal passages open into a larger terminal portion, which is the nasal pharynx. Of these the authors remark that the right nostril is "beaucoup plus étroit que la gauche." But in the figure the smaller of the two ("g") ‡ is lettered as the left! It seems to me to be quite likely that variations occur, and that the authors saw examples of both conditions. At any rate, they are equal in my much younger foetus. It is to be noted that this terminal region of the nasal canals presents the appearance in the fully-developed animal of a distinct and large chamber, into which open—as if they were ducts—the two separate nasal passages. Its origin as a mere fusion of these two tubes is not exactly indicated in the adult.

The left nasal passage has no such specialisation. It is, however, different from the same passage in the young foetus described above, in that it possesses "dans toute son étendue . . . intérieurement un bourrelet saillant." This structure is suggestive of the typhlosome of the earthworm's intestine. It also occurs in the lesser Sperm-Whale, *Cogia*, where it has been described by Benham §, and later by Danois || and Kernan and Shulte ¶, whose accounts are not in exact harmony as to several points. It is to be noted, however, that the right nasal passage is dilated along its

* "Recherches sur le Cachalot," Nouv. Arch. Mus. (3) iv. pp. 1-30.

† Ann. Durban Mus. vol. ii. pt. 4, p. 134 *et seq.*

‡ *Loc. cit.* pl. vi. fig. 3.

§ "On the Anatomy of *Cogia brevicauda*," Proc. Zool. Soc. 1901, vol. ii. p. 107.

|| "Recherches de l'Anatomie . . . de *Kogia*," Arch. Zool. Exp. (5) vi. (1910).

¶ "Memoranda upon . . . foetal *Kogia*," Bull. Amer. Nat. Hist. Mus. xxxviii. (1918).

length, and opens anteriorly in common with left much in the same way as these tubes are related in *Physeter*. It is unnecessary to go into further details of comparison, as the object of this paper is the description of the structure of a fœtus of *Physeter*. And I have not noted that this fœtus presents a closer likeness to the adult *Cogia* than it does to the adult *Physeter*.

Messrs. Pouchet and Beauregard supply in their memoir a very useful sketch of a transverse section*, which throws some light upon the different proportions of the regions of the blow-hole in their specimen and in that which I describe here. The section in question is of a young male animal with a head of 1.30 M. in length. It shows the much greater extent in this, of course, practically adult whale of the dilated region of the right nasal passage, which their measurements allow me to compare with the corresponding ones of my fœtus. The section is taken at a distance of 40 cm. from the snout, *i. e.*, occupying a position at about the end of the first third of the head. The dilated chamber in the fœtus is very much shorter. It ceases to be dilated at about the 24th slide, out of a total, which embrace the head, of 180 odd slides. Thus the two nasal passages are not very different in size after the first seventh or eighth of the total length of the head. It is clear, therefore, that a great deal of growth takes place anteriorly to this point as the fœtus advances towards maturity. I shall have to refer to this figure again in considering the internasal cartilage and the position of the spermaceti mass in the young whale.

§ *Cartilages of Blow-holes and Nasal Passages.*

The anterior median cartilage of the head—ethmoid, rostral, fused trabeculæ cranii, or whatever we may term it—has anteriorly, in this fœtus, no connection at all with the cartilages which partly envelop the nasal tubes. It is a rounded rod (in transverse section) which terminates anteriorly in quite close connection with the epidermis, being prolonged there in a straight line from the basicranial axis of which it is, of course, the anterior part. Posteriorly, however—and we shall come to this matter presently,—a ridge arises from the dorsal surface of this rod of cartilage, and is connected (indeed, quite fused) with the median rod of the nasal cartilages. It is interesting to note that

* *Loc. cit.* pl. vi. fig. 2.

this lack of connection between the rostrum throughout its length with the nasal cartilages persists into the adult state (or practically so), since Messrs. Pouchet and Beauregard figure no connection between the two so far back as a distance of 40 cm. from the snout in a head of a "young male," which is itself (the head) 1.30 M. long *. The connection of the two would appear, therefore, to be quite secondary, and there are other facts which support this view. These concern the development of the cartilages in question. The rod-like rostral cartilage seems to be growing from before backwards, and the growth seems to be taking place in the formed cartilage and not in the surrounding tissues of the head. It is quite otherwise with the cartilages of the nasal tubes.

Here the first beginnings of the nasal cartilages are seen to be—as is, of course, well known in the development of cartilage—a condensation of the nuclei of the mesoblast in the neighbourhood of the nasal grooves.

The actual condensation of the tissue to form the "pro-cartilage" begins very early in the head, immediately behind the anterior groove into which the two nasal tubes open. Actual cartilage is not formed until later, about .75 mm. behind the said groove. The first cartilage to be formed is that which lies on the dorsal surface of the right nasal cavity; a very short way further back the median internasal cartilage puts in an appearance, and a little later still that of the left nostril. These cartilages are everywhere independent from each other as cartilages in the present region of the snout; but they are all connected by the dense tissue with crowded nuclei which is the forerunner of the cartilage. It will be noted, therefore, that the asymmetry of the blow-holes is seen also in their cartilages. I could find no trace whatever here, or in the hinder region of the nasal cartilages, of any extension on to the ventral surface of the nasal tube, such as is represented by Kükenthal to occur in *Phocæna* †. They are here purely dorsal. Early in the series of sections the cartilage of the right nostril extends more or less right along it. But as we pass backwards in the series this transversely elongated cartilage becomes divided into two, of which the outermost extends back for a very short way and then ends. The other reaches much further towards the skull.

* *Loc. cit.* pl. vi. fig. 2.

† "Die Walthiere," Denkschr. Nat.-Med. Ges. Jena, Bd. iii. Theil 2, p. 322 &c., pl. xxiii. figs. 4, 5, 6.

It may be further pointed out that at the beginning of the cartilage covering the right nasal tube—where it is wide, completely separated here from the groove on the surface of the head, and lying in a direction at right angles to the vertical axis of the head—the cartilage considerably overlaps the nasal tube; it extends beyond it towards the lateral surface of the head, but also slightly upwards for a distance of perhaps half the length of the tube itself. Later on what has been the dorsal surface of the nasal tube becomes its outer lateral side, and ultimately there are other changes, as we have already described in considering the course of the nasal tubes. In fact, what is originally the dorsal surface of the nasal tube becomes ultimately—after the two tubes are fused to become the nasal pharynx—the ventral surface, owing to the gradual twist, already described, in the course of the tube. We cannot therefore insist upon an exact comparison between the cartilages associated with it and those associated with the very different nasal passages of *Phocæna* referred to above.

On the left side this narrow cartilage ultimately fuses with the median piece, but I could not detect a similar fusion on the right side. It is finally overwhelmed by the growth of a second outgrowth of the median cartilage, which I take to be the ali-ethmoid. The anterior cartilages are presumably to be regarded as the ali-nasals*. The fusion of ali-nasals and ali-ethmoids is accomplished at a distance of about 9 mm. from the extremity of the head. There is no connection between the median internasal septum and the upgrowth of the basal portion of the ethmoid until a point at about 6 mm. from the anterior end of the head. And, moreover, this point is quite easy to detect. The median nasal cartilage, lying between the two blow-holes, up to a point about 6 mm. from the anterior end of the snout, is perfectly symmetrical. But the incompletely or wholly unchondrified tissue surrounding it bends to the right at its end. In the next section this is seen to contain a cartilaginous rod which is the median dorsal growth of the ethmoid, and thus would seem to have fused with the median nasal cartilage rather than to have arisen as an outgrowth from it. It will be noted also that from this point the median septum of the head acquires a symmetrical position and is no longer on the left side as in the anterior

* See, e. g., W. K. Parker, "On the Structure and Development of the Skull in the Mammalia. Part II. Edentata; Part III. Insectivora," Phil. Trans. Roy. Soc. 1885.

nasal region. It comes, so to speak, under the influence of the mesethmoid, which is from the first to the end quite median. The oblique course of the nasal section of the cartilage gradually straightens to the median position.

§ *Lining Epithelium of Nasal Passages.*

The anterior section of the two nasal passages is lined with a continuous epithelium, which in all—or, rather, the much greater part of—my sections has become detached from the muscular and connective-tissue walls of these passages. This has also led, as I imagine, to the disappearance of some of the sections of the lining epithelium. For during the process of cutting the sections the whole head of the animal had to be unmounted, dealt with further, and re-imbedded in the paraffin. Thus it is difficult to be absolutely certain how far the epithelium, with the characters which I shall immediately describe, extends along those tubes towards the posterior opening into the pharynx. They extend, at any rate, a long way behind the dilatation of the right blow-hole. At first the detached epithelial lining forms a solid rod-like structure in the sections with a slight swelling at each end, giving to it here a club-like form. It is solid throughout and has no central cavity. There is, however, a differentiation into a cortical layer, so to speak, and a medullary layer. The former is more densely stained, and is composed of columnar cells. The central part is formed of non-columnar cells less stained. Later on a vacuity appears in the two club-shaped extremities referred to above, and later still the epithelium clings to the actual wall of the nasal passage, and the central layer of the fused epithelium of the whole periphery has disappeared.

The state of affairs visible in this foetus evidently leads to the complete occlusion of the nostrils in the anterior part, and is precisely what is to be found in the developing *Apteryx*, according to the late Prof. T. J. Parker*.

§ *Dilator and Occluser Muscles of Nasal Passages.*

These muscles are very distinct, especially those which dilate the passages; this conspicuous appearance of the dilator fibres is due to the fact that in transverse section they are seen throughout their whole length radiating out

* "Observations on the Anatomy and Development of *Apteryx*," Phil. Trans. vol. 182 B, 1891, p. 25.

from the margins of the passages in question. The constricting muscles are by no means so obvious, since they are seen as transversely-cut fibres lying between the former, which in the same way are hardly massed into bundles, a state of affairs which doubtless will be seen later in development. The dilator muscles extend throughout the whole course of the nasal passages while they lie outside the bones of the skull. They are less developed, however, in the later sections. The muscles are particularly conspicuous for a distance of nearly 4 mm. They are not only attached to the margins of the blow-tubes, but to the cartilages associated with these. I could see no striation in these fibres*.

§ *Nasal Pharynx.*

After the fusion of the two nasal canals into one, the respiratory passage may be termed the pharynx—or, better, perhaps, as it has been called, the naso-pharynx. This region occupies altogether twenty slides of the series upon which I have worked; and its length in millimetres will be, therefore, as near as may be, 6·5. It is thus a trifle more than half of the length of the double region of the nasal passages which precedes it. Clearly, therefore, it is notable for its length, when compared proportionately with other mammals. It is also actually very long in relation to whole head of the whale.

For a considerable distance no particular change occurs in the shape of the tube; the two halves do not become more intimately connected, and continue to lie at an angle with each other—the two limbs representing the two separate blow-hole passages joining below and diverging above. Later the angle becomes greater and the whole acquires a more flattened aspect from above downwards. It is in this region that the Eustachian tube arises, which I deal with later. Later still—at any rate, within 6 mm.,—the tube gets to have a triangular section, the flat side being dorsal, and ridges appear which run longitudinally. Almost directly the whole tube becomes much more elongated from above downwards and narrow from side to side, and has a series of ridges along both sides, appearing, of course, in the sections as short ingrowths into the lumen. Later still it again acquires a triangular form in section; but this time

* For the matter of that, I could find no striation of any of the voluntary muscles of that region of the body of this fetus which I have hitherto studied, viz. the head.

the apex of the triangle is above and the base below, and the walls are but little plicated. It is in this stage when the oropharynx communicates with it from below.

§ *Spermaceti Organ.*

I have not been able to ascertain the presence of a regularly defined spermaceti organ in this young fœtus. The organ is figured by Pouchet and Beauregard* in their often-quoted memoir as lying on the right side above and to the right of the right nasal passage, which is here inclined obliquely downwards from the middle line of the head towards the right. It is also represented as lying within a distinctly marked fibrous sheath. This animal is, however, a young male, of which the head is 1·30 M. Messrs. Kernan and Shulte† deal with the same organ in a fœtal Pygmy Sperm-Whale, which is large, measuring in total length 109·7 cm. Contrary to the statements of Pouchet and his colleague, these two authors find no connection between the spermaceti sac and the nasal passage. But (they add) "we may indeed think of the spermaceti chambers as belonging embryologically to the nasal tract." As the embryo examined by these authors is, as I have already pointed out, a large one, it became a matter of great interest to myself to endeavour to follow out this matter in a much younger fœtus. In searching for the spermaceti organ it was obviously unnecessary to go further back than the dorsal upgrowths of the maxillary bones which in the adult bound posteriorly the "case" which contains the oil.

The space, therefore, where only the spermaceti organ can lie in the fœtus is limited to that part of the whole snout which is relatively small in the fœtus, *i.e.*, about 6·5 mm., but which expands enormously in the adult. The other organs lying in this part of the snout, *i.e.*, nasal passages, muscles, &c., bring it about that the organ, if present, must lie medianly in position. And, as a matter of fact, the middle region here is filled with a lax tissue with branched cells; this is undoubtedly, as I think, the beginning of the organ sought for. But it has in this stage no trace that I could discover of a sheath, fibrous or otherwise. And, moreover, there is at the same time no indication

* *Loc. cit.* pl. vi. fig. 2.

† "Memoranda upon the Anatomy of the Respiratory Tract... of the fœtal *Kogia breviceps*," Bull. Amer. Mus. Nat. Hist. xxxviii. 1918, p. 231. See also Danois, "Recherches de l'Anatomie de la Tête de *Kogia breviceps*, Blainv.," Arch. Zool. Exp. (5) vi. 1910, p. 149, etc.

of a metamorphosis of the right nor, for the matter of that, the left nasal passage, which suggests a commencing modification in the direction of the formation of the spermaceti organ. Nor, on the other hand, is there any diverticulum which might suggest the same. Evidently, therefore, if the connection alleged by Pouchet and Beauregard actually exists, it must be in a later fœtus. I am disposed, therefore, to think that the positive statements as to the absence of any such relation between the nasal passage and the spermaceti organ made by Kernan and Shulte are at the moment more likely. Nor does it to my mind seem the kind of connection that might be expected. An early outgrowth might be a different matter; but that, as I believe, is not to be found.

§ *Oropharynx and Tonsils.*

The tonsils have not been, as far as I am aware, described in the adult Sperm-Whale; they occur, however, in the fœtus under consideration. They have also been studied in the Pygmy Sperm-Whale, *Euphysetes*, by Kernan and Shulte*. They are represented in the latter by "two crypts . . . dorsally placed." And each crypt consists of a slit-like orifice leading into a little pocket. There are, say these authors, "no conspicuous lymph follicles." In the embryo Sperm-Whale examined by myself the tonsils do not occupy a large space; they are to be seen for a space of about 1.2 mm., perhaps a very little more, for it is difficult to fix accurately the end of the outgrowths which form the canal of the tonsil, so gradually does it fade away on each side. In the series of sections examined by me, the tonsil of the left side first came into view; and, moreover, it persisted after the appearance and disappearance of the right tonsil. I may here point out that the first appearance of the Eustachian tubes is also on the left side. There would, therefore, appear to be a precise agreement in the nature of the asymmetry of these organs in the whale's head. But it is important to bear in mind that it is not easy to orient exactly so large an object as the head of this fœtus in the imbedding material, so that the sections shall be precisely at right angles to the longitudinal axis of the head. There is clearly scope for error. But, in any case—even if the apparent agreement of the asymmetry of the two organs is so far accidental,—there is no doubt whatever

* *Loc. cit.*

that the tonsils are asymmetrical. For the left gland not only appears first but ends last.

There is a further asymmetry between the two tonsils. It is only that of the left side which possesses a coating of lymphoid tissue upon the canal of the tonsil. This seems to be completely absent in the case of the tonsil of the right side. The canal is quite dorsal in position, and runs upwards for its greater length, and then bends quite—or nearly so—at right angles to run backwards for a little way. In the series of transverse sections, therefore, the canal is for the greater part of its extent cut longitudinally, and then the extreme distal end is cut at right angles. The opening into the oropharynx is really rather slit-like, only the median part of this slit being prolonged into the tube. The particular form which the tonsils of this animal show are interesting in view of the general state of affairs as to the tonsils in the Mammalia—a subject which has lately been reviewed with many additions.

In the paper referred to* the authors regard a long tubular tonsil as “the starting-point of the series,” and this condition, occurring in the tiger and the leopard, is to be seen in the early fœtal condition of man. It is to this type that the tonsils are to be referred in the *Sperm-Whale*, as it appears to me. But the conditions are much exaggerated in the whale. Its independence of the walls of the pharynx, and the length to which it projects outside of those walls in a fœtus, which, though small, is in some respects very advanced, are highly remarkable. This is so obvious that it need not further be commented upon.

The comparison of this tonsil with a rudimentary gill-cleft is also obvious. But the position might at first appear to militate against this generally-accepted view. In the case of the Eustachian tube, the origin of the tube is distinctly ventral, but the tonsil is as distinctly a dorsal outgrowth of the lining epithelium of the oropharynx. There is, as I think, no possibility of denying their essential similarity. If it be held that the posterior part of the nasal passage or passages is not a part of the primitive ingrowth of the olfactory organ, but a longitudinal division of one tube, then the differing position of two, probably serially homologous, outgrowths becomes intelligible. For if we, so to speak, rejoin the two tubes oral and respiratory, the two pairs of diverticula will both be relegated to, and

* Secombe Hett and Butterfield, “The Anatomy of the Palatine Tonsils,” *Journ. Anat. Phys.* xliv. p. 35.

be outgrowths from, the middle region of this tube, which is precisely what a gill-slit is in other animals.

A final matter of interest in connection with the tonsils of the Sperm-Whale is the variable occurrence of these organs among the Cetacea. Shulte*, in a foetus of a Rorqual, "found no trace of a tonsil." This is, however, not a question of whalebone-whales differing from the Odontocetes, for Macalister† also "found no trace of a tonsil" in *Globicephalus melas*, while Murie‡, in his elaborate account of the same whale, does not mention that organ.

LXXV.—*On Mammals from the Li-kiang Range, Yunnan, being a further Collection obtained by Mr. George Forrest.*
By OLDFIELD THOMAS.

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THANKS again to the generosity of Col. Stephenson Clarke, C.B., the British Museum has received as a donation a further series of mammals from the highlands of Yunnan, additional to those described by Mr. Hinton and myself in previous numbers of the 'Annals.' The present series, which numbers about 300 specimens, were all obtained in the Li-kiang Range (27° N., 100° 30' E.), and on this account I have repeated here the names of the only species from that range obtained in the first collection but not in the second; so that the present paper forms a complete list of all the mammals as yet known to occur there.

Naturally the great majority of the species now received were included in the first collection, but, none the less, this supplementary collection is a most valuable addition to the Museum, especially as the specimens were for the most part collected at a different time of the year, so that seasonal changes, previously unknown to us, are now generally represented.

Some new forms do occur, however, notably a flying squirrel of the rare genus *Trogopterus*, the new species being

* "Anatomy of a Foetus of *Balenoptera borealis*," Mem. Amer. Mus. Nat. Hist. (n.s.) i. pt. vi. 1916, p. 432.

† "On some Points in the Anatomy of *Globicephalus siveinal* (Gray)," Proc. Zool. Soc. 1867, p. 450.

‡ "Organisation of the Ca'ing Whale, *Globicephalus melas*," Trans. Zool. Soc. vol. viii. 1874, p. 252 *et seq.*